made, and to point out and direct attention to some of the many problems that suggest themselves more or less urgently at each step forward.

The term "gall" is employed in almost the same sense as by Dr. Ross, and the subjects treated of by him are also met with in this work; but the whole subject is discussed far more thoroughly, and from other points of view, with very copious notes and bibliographical references.

The introduction gives a historical outline of the investigation of galls from the earliest records onwards. Some of the earlier beliefs as to their origin are similar in kind with the strange explanations of the origin of fungi at the same period; and they form a striking contrast to the views expressed by Malpighi, the founder of the scientific study of galls, in his treatises, "De gallis" and "De variis plantarum tumoribus et excrescentiis." But for a long period after Malpighi, little interest was shown in them except by Réaumur, and a catalogue of galls due to animals (zoocecidia) published in 1858 included only about 300. How rapidly knowledge has advanced since then is evident from the catalogue by Houard, issued in 1909, enumerating more than 6000 from Europe and the Mediterranean area of Africa and Asia, while numerous records have recently appeared on the galls of many other regions.

Dr. Küster divides his book into comprehensive chapters devoted to the great divisions of his subject, beginning with one on the gall-producing animals and plants considered class by class. The second consists of a review of the gall-bearing plants, also treated systematically. The situations of galls on their hosts and their morphology receive very full consideration, as do also their internal structures and their relations to the healthy tissues of the host-plants. Then follows a brief account of the chemistry of galls, including the physiological processes that go on in them. The two last chapters are the most important and suggestive of all, the one being devoted to the etiology and the other to the biology of galls. Under etiology are considered the prerequisites for their formation, the varying degrees of ability shown by the gall-makers to originate and to develop them, general questions as to means employed by their makers, the formation of galls as affected by absorption, nutrition, and wounds, their connection with alterations of correlation in the members and tissues of the host, their tendency to induce permanent variations (very slight, as tested by cases where the growth extends beyond a gall), abnormal galls, and the information that they yield as to their etiology, and as to the effect on their growth of the death of the maker or its early abandonment of the gall. The great need of further efforts to produce galls experimentally is dwelt on, while the small result from the experiments of the past is fully recognised, and makes still more evident the need to observe very carefully the actual course of things in the development of galls, both normal and abnormal. Many show themselves to result from stoppages of advance in complexity, while increase goes on in mass of tissues.

Under the biology are included a number of most interesting topics, such as the grade of restriction to certain host-plants, alternation of generations, with or without alternation of hosts, tendency to produce "physiological species" or races restricted to certain hosts, though scarcely differing morphologically, relative frequency in various habitats (*e.g.* water plants, dry moor and mountain floras, deciduous trees, &c.), methods of distribution in space, palæontology, relations between galls and their makers (duration of life, sexual dimorphism of galls, methods of emergence of makers), effects of galls on welfare of host, and relations to other organisms (feeders on galls, inquilines, "ambrosia," and parasitic fungi, &c.).

A brief account is given in an appendix of the relatively few galls ("thylacia") upon the bodies of animals.

Space will not allow of quoting any of the remarks on the numerous problems to which the reader's attention is directed as in need of investigation. For these, as for much else, we must refer those interested in galls to the work itself, assured that they will find no better or more trustworthy guide. Its value will be most fully felt by those who have already gained some knowledge of galls in the field. As already stated, it does not aim at being a descriptive catalogue. Numerous good figures in the text (not always correctly referred to, however), and a sufficient index add to the value of this excellent work.

SOIL STRUCTURE AND PLANT GROWTH.

Boden und Klima auf kleinstem Raum. Versuch einer exakten Behandlung des Standorts auf dem Wellenkalk. By Prof. G. Kraus. Pp. vi + 184 + Taf. vii. (Jena: Gustav Fischer, 1911.) Price 8 marks.

NO one can pass from a sand to a chalk formation without being struck by the very sharp changes in vegetation, even where similar climatic conditions persist, changes which clearly indicate marked or even fundamental differences in soil conditions. But so far as we know no one has taken the trouble to investigate a particular case with anything like the completeness it de-

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serves. The author of the present volume set out to remedy this deficiency by making adequate study of a little region near Karlstadt-on-the-Main, where the sandstone with its green woods and red, moist soil gives place to limestone and a dry, glistening white soil.

In similar instances it has been the practice to attribute the difference of flora to the presence of calcium carbonate in the limestone soil and its absence from the sandy soil, and the author began with this hypothesis in view by making numerous determinations of calcium carbonate in the soil. But he was soon driven to the conclusion that calcium carbonate is an exceedingly variable quantity; indeed, he doubts whether any estimate can be obtained of the amount in the layers of the soil immediately in contact with the plant root. Making the determination in the accepted way, however, and comparing the analytical results with the vegetation, he failed to find any plant that occurred exclusively on soils of even approximately the same calcium carbonate content; there were always variations within very wide limits. A vague relationship only could be traced: some plants showed a clear preference for soils containing a high amount of calcium carbonate, whilst others were found on soils containing only small quantities. Thus *Festuca glauca* occurred on soils containing 28 to 64 per cent., *Teucrium montanum* on soils containing 11 to 73 per cent.—more generally, however, when more than 35 per cent. was present—and *Melica ciliata* where 24 to 60 per cent. occurred. Against these the limits for *Brachypodium pinnatum* were 2 to 43 per cent., for *Koeleria cristata* 1·4 to 27 per cent., and for *Hieracium pilosella* 16 to 56 per cent.

A mixed flora was found where the limestone merged into the sandstone. True chalk plants like *Pulsatilla* and *Hippocrepis* grew in spots where calcium carbonate was absent, while calcifugous plants like *Calluna* and *Vaccinium* were found in places where more than 3 per cent. of calcium carbonate occurred, and alongside *Anemone sylvestris* flourished. With the exception of a few plants that require large amounts of calcium carbonate the author seems to have found most of the local calcicolous plants on soils entirely free from calcium carbonate. He has completely lost faith in the lime content of the soil as a true basis of discrimination, and looks forward to the time when every calcicolous plant shall have been found on chalk-free soils.

The wandering of plants for which calcium carbonate is supposed to be essential on to chalk-free soils has been already observed, but never accounted for. When exceptions to a rule begin to crop up, there is a strong temptation to invent a new name to describe the exceptional case and after a while to take the name as an explanation of the phenomenon, and the cynic might argue that something of the sort has happened with the word invented in this instance—heterotopism. The present author, however, goes further; since the calcium carbonate hypothesis fails, he turns to a second hypothesis, the view that the physical properties of the soil and not the calcium carbonate really determine the distribution of plants. The particular set of properties best suited to calcicolous plants are usually found in soils rich in calcium carbonate, while those suited to calcifugous plants are associated with soils poor in calcium carbonate; but the carbonate itself does not play the controlling part in the matter. The author is not prepared to say that calcium carbonate exerts no specific action on the plant, but he knows of no proof that it does. Even small quantities of calcium carbonate are known to affect markedly the properties of the soil; he therefore made mechanical analyses, determined water-contents and temperatures of the soils, and also noted their aspects and general relation to their surroundings. Working over very small areas in great detail, he finds distinct similarity in general physical conditions on spots where the same plants are growing. In the last instance the physical properties of the soil are some function of the soil structure, which therefore he considers to be the determining factor.

Whether the author's conclusions are wholly justified can only be ascertained by further experiments, but he certainly makes out a strong case for his main thesis that the botanist must pay more attention to the properties of the soil if he wishes to account for the distribution of plants. The book will be found of much interest to ecologists as a piece of painstaking and methodical work, and it emphasises the important fact that careful investigation over a limited area is likely to prove very fruitful in the study of ecology.

E. J. Russell.

THE ADVANCE OF PHOTOGRAPHY.

The Advance of Photography: its History and Modern Applications. By A. E. Garrett. Pp. xiii + 382. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1911.) Price 12*s.* 6*d.* net.

It is about forty years since Dr. Hermann Vogel wrote his volume entitled "The Chemistry of Light and Photography in their Application to Art, Science, and Industry" for the "International Scientific Series," so well known by their red covers. The copy before us is a "new and revised" edition issued in 1876, and about two-fifths of its contents are devoted to historical

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